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Editorial Comment

Contrast Echocardiography in the Doppler Color Flow Imaging Era*

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After its description by Gramiak and Shah (1) at the University of Rochester, contrast echocardiography was initially used mainly for structure identification. This application was rapidly rendered obsolete as instrumentation and clinical experience with two-dimensional echocardiography improved. The second major application for contrast echocardiography was the detection of abnormal flow patterns in congenital heart disease: shunts, anomalous connections or absence of normal functional continuity. Several clinical series using contrast echocardiography in congenital heart disease were reported in the 1970s (2,3). During the 1980s, however, this application has been largely replaced by pulsed, continuous and especially Doppler color echocardiography. The review by Van Hare and Silverman (4) in this issue of the Journal summarizes their experience with contrast echocardiography in congenital heart disease over the past 12 years. It gives a perspective on where contrast continues to be useful in the Doppler color flow imaging era.

Shunts. Contrast studies are very sensitive for detecting small shunts at low velocities, such as right to left shunt due to patent foramen ovale or persistent fetal circulation. Doppler echocardiography is better for detecting small high velocity shunts such as those due to a left to right shunt through a small ventricular septal defect (maladie de Roger).

Assessment of flow connections. The destination of venous blood can be assessed by contrast echocardiography. For example, left superior vena cava to coronary sinus connection can be demonstrated by contrast echocardiography after injection of contrast medium into the left arm (5). Following the course of venous or arterial blood flow can be helpful also in more complicated congenital lesions such as transposition of the great vessels, tricuspid atresia, hypoplastic left ventricle and various cardiac situs problems. Also, the demonstration of forward flow for the differentiation between critical pulmonary stenosis and atresia is more reliable by contrast than by Doppler echocardiography. The same method can be used to confirm interruption of venous flow as in interruption of flow in the inferior vena cava. Contrast echocardiography is useful to determine the location of the venous atrium in cases of dextrocardia and situs inversus. This type of physiologic information cannot be obtained by Doppler echocardiography alone.

Arteriovenous malformations. Arteriovenous fistulas can appear in different organs and are usually classified as systemic (or peripheral) and pulmonary types. These shunt are often difficult to localize by conventional Doppler echocardiography. Van Hare and Silverman (4), as well as previous investigators (6), found that contrast echocardiography is useful in identifying arteriovenous malformations. In the presence of a pulmonary arteriovenous fistula, contrast medium injected into a peripheral vein will appear in the left side of the heart. The delay in appearance of contrast in the left heart chambers, compared with the time of appearance in the right heart chambers, helps differentiate extracardiac from intracardiac shunts (7).

Evaluation of therapy. In some situations, contrast echocardiography can be helpful in evaluating the results of therapy. The improvement of atrial level mixing due to Rashkind balloon septostomy can be better assessed by contrast echocardiography than by Doppler imaging.

Future applications. With the development of new contrast agents like sonicated albumin (8), and the introduction of commercial agents such as Albunex (Molecular Biosystems) and Echovist (Schering), the applications of contrast echocardiography are expanding. Sonicated albumin is nontoxic and can transit the pulmonary circulation after intravenous injection. The way is opened for improved automatic edge detection algorithms using left heart contrast enhancement. Time-intensity curves created by videodensitometry are correlated with blood flow giving contrast echocardiography a quantitative ability. Contrast medium can be used to enhance low intensity Doppler signals, thereby bringing out information on Doppler studies otherwise not available because of a poor signal to noise ratio. Perhaps the most exciting application of contrast echocardiography in adult and in some pediatric patients with congenital malformations is in myocardial perfusion imaging. Over the past 5 years this use has been validated in animal and human studies, although adequate myocardial perfusion imaging in humans currently requires left heart injections.

Conclusions. Many of the initial uses of contrast echocardiography have been replaced by Doppler echocardiography. However, the review by Van Hare and Silverman (4)

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makes it clear that contrast echocardiography has continued utility in the diagnosis of congenital heart disease. New contrast agents and quantitative methods of contrast measurement will further expand the applications of contrast echocardiography during the 1990s.

References

1. Gramiak R, Shah PM. Echocardiography of the aortic root. Invest Radiol 1968;3:356–66.
2. Seward JB, Tajik AJ, Spangler JG, Ritter DG. Echocardiographic contrast studies: initial experience. Mayo Clin Proc 1975;50:163–92.
3. Sahn DJ, Allen HD, George W, Mason M, Goldberg SJ. The utility of contrast echocardiographic techniques in the care of critically ill infants with cardiac and pulmonary disease. Circulation 1977;56:599–603.
4. Van Hare GF, Silverman NH. Contrast two-dimensional echocardiography in congenital heart disease: techniques, indications and clinical utility. J Am Coll Cardiol 1989;13:673–86.
5. Snider AR, Ports TA, Silverman NH. Venous anomalies of the coronary sinus: detection by M-mode, two-dimensional and contrast echocardiography. Circulation 1979;60:721–7.
6. Hernandez A, Strauss A, McKnight R, Hartmann A. Diagnosis of pulmonary arteriovenous fistula by contrast echocardiography. J Pediatr 1978;93: 258–61.
7. Kronik G. Contrast echocardiography in patent foramen ovale. In: Meltzer RS, Roelandt J, eds., Contrast Echocardiography. The Hague: Martinus Nijhoff, 1982:149–50.
8. Feinstein SB. Contrast agents for ultrasonic imaging. U.S. Patents 4,572,203 (Feb. 25, 1986) and 4,718,433 (Jan. 12, 1988).